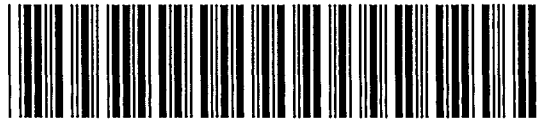


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Program IHS (IHS)

DocCat FACILITY

COMPREHENSIVE SITE ASSESSMENT

at

*DURHAM QUARRY
Denfield Street
Durham County
Durham, North Carolina
DEM Facility # 0-012984
Groundwater Incident # 9357*

for

*Teer Company
Post Office Box 13983
Research Triangle Park,
North Carolina 27709-3983*

by

GEONETICS CORPORATION

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Geonetics Corporation

October 28, 1993

TABLE OF CONTENTS

	<u>Page</u>
EXECUTIVE SUMMARY	1
Purpose and Site History	1
Initial Abatement / Emergency Reponse Information	1
Nature and Extent of Release	4
SITE HISTORY & SOURCE CHARACTERIZATION	6
POTENTIAL RECEPTORS & MIGRATION PATHWAYS	10
REGIONAL GEOLOGY & TOPOGRAPHY	14
SITE ASSESSMENT	17
Soil Borings and Sampling	17
Groundwater Investigation	29
Groundwater Levels and Flow Directions	40
CONCLUSIONS AND RECOMMENDATIONS	45
REPORT CERTIFICATION	47
REFERENCES	48
APPENDIX	Separate Binder

LIST OF FIGURES

	<u>Page</u>
Figure 1. - Location Map	2
Figure 2. - Site Map	3
Figure 3. - Well Inventory Map	11
Figure 4. - Regional Geologic Map	15
Figure 5. - Soil Borings and Soil Contamination Map	26
Figure 6. - Cross-sections A - A' and B - B' Soil Contamination	28
Figure 7. - Monitoring Wells and Groundwater Contamination Map	37
Figure 8. - Cross-section A - A', Groundwater Contamination	38
Figure 9. - Cross-section B-B', Groundwater Contamination	39
Figure 10. - Perched Water Table Contour Map	43
Figure 11. - Deeper Water Table Contour Map	44

LIST OF TABLES

Table 1. - Potential Receptor Wells.	10
Table 2. - Adjacent Property Owners	13
Table 3. - Soil Laboratory Analyses	18
Table 4. - Soil OVA Measurements	22
Table 5. - Well Construction Data	30
Table 6. - Summary of Groundwater Analyses	34
Table 7. - Water Level Data	42

EXECUTIVE SUMMARY

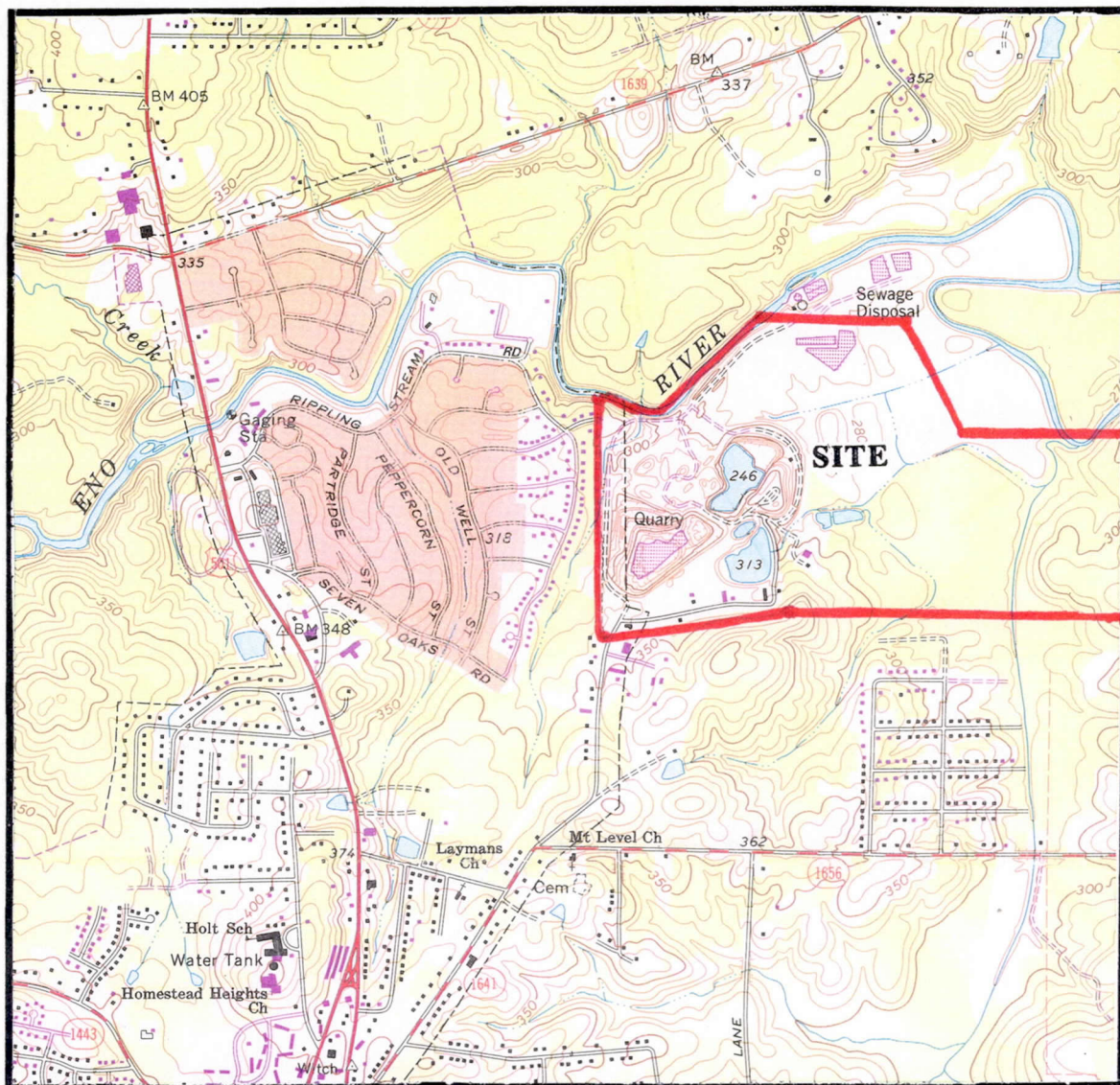
Purpose and Site History

This CSA report presents the assessment and interpretations of a petroleum contamination study at a mining and processing site, the Durham Quarry, located at the end of Denfield Street (State Road 1641), north of Durham, in Durham County; Figures 1 and 2. An unknown amount of fuel leaked into the soil and groundwater, from the area of one or more of four gasoline tanks, two diesel tanks, and a used oil tank; and possibly the distribution lines and dispensers. The age of these tanks is not known. The fuel tanks were removed in December, 1988 when the service station was taken out of service.

The property is presently owned and operated by Teer Company. It has been in operation as a crushed stone quarry and processing plant since the 1940's, for use in highway and other construction materials. The North Carolina Department of Transportation originally owned and operated the site as a quarry and an asphalt batch plant. The property and these facilities were subsequently sold to Teer in 1951. The asphalt plant has since been relocated to another site. The N.C. Division of Environmental Management (DEM) has assigned Groundwater Incident # 9357, and the Site Facility # 0-012984.

Initial Abatement/Emergency Response Information

No free product was found during this investigation. There was no Initial Remedial Action on site, following the closure. Contamination was later suspected in one of the supply wells, and they were sampled for laboratory analyses. Notification of the contamination was submitted to DEM's Raleigh Regional Office on October 2, 1992.



0' 2000' 4000' 6000'

Northwest Durham 7.5 min. Quad
USGS, 1987 (Revised)

Figure 1 - Location Map

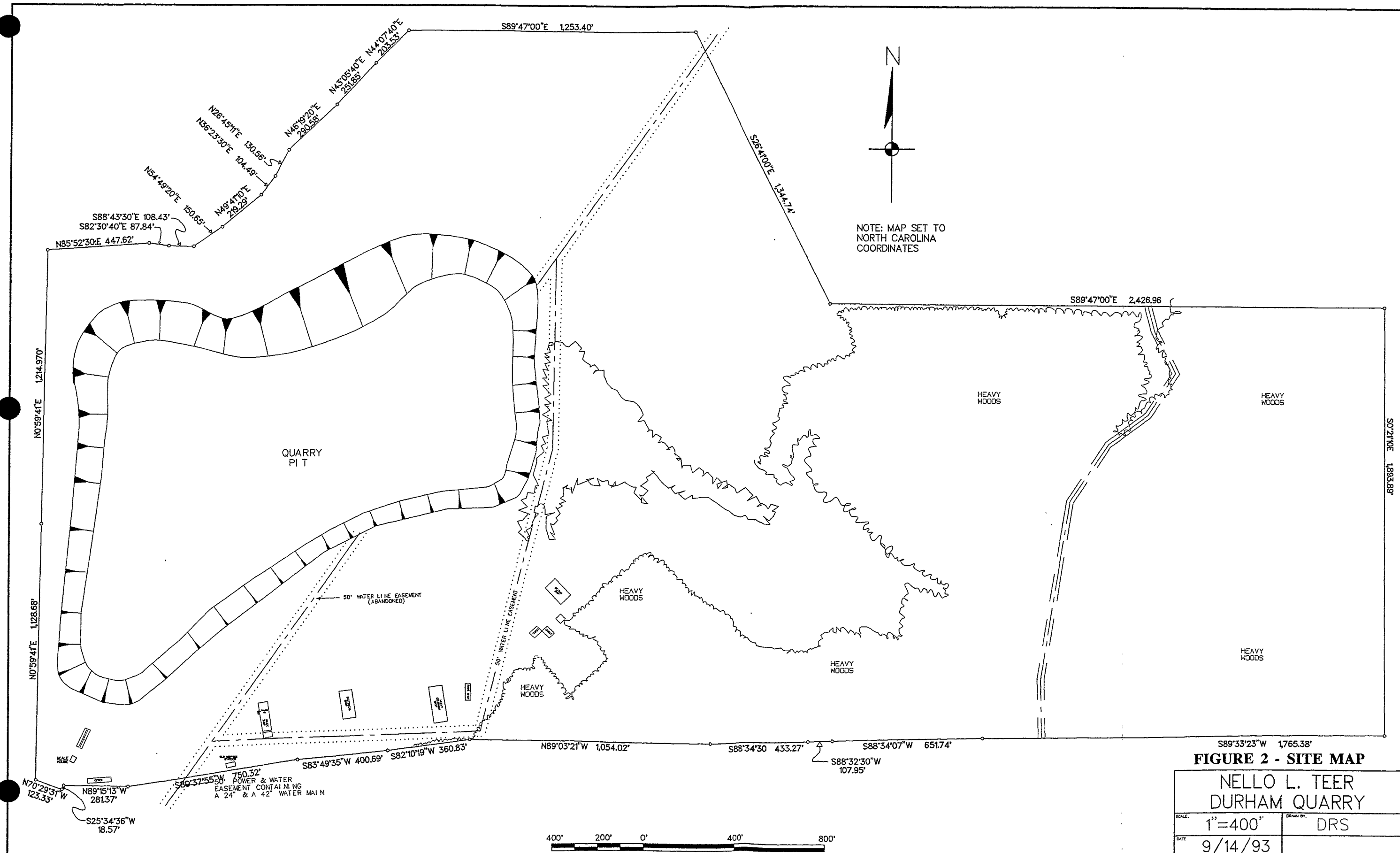


FIGURE 2 - SITE MAP

NELLO L. TEER
DURHAM QUARRY

SCALE: 1"=400'

DATE: 9/14/93

DRS

GEONETICS CORPORATION

Nature and Extent of Release

A well inventory has been completed which identified 15 supply wells within 1,500 feet of the site. Only one of Teer's on site supply wells is known to be affected by the contaminant migration from the release. The groundwater contamination appears to have remained on the site. There is no migration toward the Eno River, north of the property.

Laboratory results indicated that the greatest soil contamination is: TPH at 117 mg/kg (ppm) (EPA Method 5030); TPH at 2,800 mg/kg (EPA Method 3550); and TPH at 572 mg/kg (EPA Method 9071). These were located in the vicinity of the former service station and the truck shop at depths from 2 to 15 feet BLS. Current DEM Guidelines prescribe reportable amounts of soil contamination to be those above: 10 ppm (Method 5030); 40 ppm (Method 3550); and 250 ppm (Method 9071). EPA thresholds are: contaminated >2 ppm; and excessively contaminated >5 ppm, for TPH.

The highest groundwater contamination is: benzene, 672 ug/L (ppb); total VOA, 3,244 ug/L (ppb); in monitoring well 2 (MW-2) from a screened depth of 14 to 52 feet, BLS. One supply well (W-1) produced water containing benzene at 12 ug/L (ppb) and total VOA at 12 ug/L, from the most recent sampling (October 5, 1993). Current North Carolina Water Quality Standards (15A NCAC-2L .0202) has established a maximum allowable concentration of 0.001 mg/L (1 ug/L [ppb]) for benzene. The contaminant concentrations on this site have been decreasing steadily since first analyzed. Bottled drinking water is provided by the company for its personnel. That well water is only used for the toilets.

The shallow (perched) groundwater flows easterly, due to a slight groundwater gradient on site and the dip of the underlying Triassic sedimentary rocks. The primary water table (unconfined) aquifer shows a south-southeasterly gradient in the vicinity of the former service station; except that supply well W-1 creates a large "cone" of depression upon the water table in this area and draws the surrounding contamination to itself. Estimated hydraulic conductivity ranges from 1×10^{-3} cm/sec (2.8 ft/day) in the sand-silt horizons, to 1×10^{-5} cm/sec (0.03 ft/day) in the clayey and silty sedimentary units.

An estimate of the volume of contaminated soil is 91,852 cubic yards (137,778 tons). Contaminated groundwater volume is estimated to be 31.12 million gallons (4.16 million cubic feet). It is proposed that the contaminated soils would be treated using bioremediation techniques on site; and that the contaminated groundwater could be remediated using in-situ sparging and/or pump and treat methods with activated charcoal. A Corrective Action Plan is being prepared for submittal by November 29, 1993.

This site is eligible for the State Trust Fund reimbursement program. Following submittal of this CSA, an application for reimbursement will be prepared for payment above the "deductable" requirement.

SITE HISTORY & SOURCE CHARACTERIZATION

The subject site is presently owned and operated by Teer Company. Previously, the site had been owned and operated by the North Carolina Department of Transportation as a crushed stone quarry, processing plant, and asphalt batch plant, since the 1940's. In 1951, Teer purchased the property. The asphalt plant was operated until 1990, when it was shut-down and relocated.

In 1986, Teer Company registered as owner of the six active underground storage tanks (UST's) on the property. The four gasoline tanks and two diesel tanks at the former service station were emptied and removed in December, 1988. They were: one 3,000 gallon gasoline, two 4,000 gallon gasoline, one 10,000 gallon gasoline, and two 10,000 gallon diesel tanks. There has been no initial remedial action at the subject site to date. No free product was encountered during this investigation.

An unusual taste and odor in the well water at the Quarry Office prompted sampling of the supply wells. Laboratory analysis found constituents of gasoline present in those samples, which was then reported to DEM in October, 1992. On January 25, 1993, a Notice of Violation was issued by the Raleigh Regional Office of DEM to Teer Company with respect to Title 15A NCAC-2L .0202, and G.S. 143-215.1. Teer contracted the services of Geonetics Corporation of Lexington, North Carolina and Lakeland, Florida to conduct the site investigation. The site activities began in March, 1993, and involved soil borings, sampling and field screening of soils around the gasoline UST's, in the southern area of the quarry property. New monitoring wells were planned, drilled and constructed so as to sample the groundwater for assessment and compliance purposes.

Immediately after petroleum hydrocarbons were first detected in the potable well (W-1), located between the Quarry Office and the truck shop, the company began supplying bottled drinking water for personnel. This well water is now only utilized for flushing toilets.

Geonetics performed a Site Sensitivity Evaluation (SSE) early in the assessment phase in accordance with DEM Guidelines. The purpose of an SSE is to evaluate the susceptibility of groundwater to contamination from petroleum-contaminated soils. It is used as a method of determining the degree of urgency in response to a spill or leak. The following DEM forms constitute the revised SSE.

ONLY CONT. OF
GW. CONT.

Site Sensitivity Evaluation (SSE)

Site Characteristics Evaluation (Step 1)

Characteristic	Condition	Rating	
Grain Size*	Gravel	150	50
	Sand	100	
	Silt	50	
	Clay	0	
Are relict structures, sedimentary structures, and/or textures present in the zone of contamination and underlying "soils"?	Present and intersecting the water table.	10	10
	Present but not intersecting the water table.	5	
	None present.	0	
Distance from location of deepest contaminated soil** to water table.	0 - 5 feet		20
	(C, D & E sites only)	20	
	5 - 10 feet	20	
	>10 - 40 feet	10	
	>40 feet	0	
Is the top of bedrock or transmissive indurated sediments located above the water table?	Yes	20	20
	No	0	
Artificial conduits present within the zone of contamination.	Present and intersecting the water table.	10	10
	Present but not intersecting the water table.	5	
	None present.	0	

Total Site Characteristics Score: 110

* Predominant grain size based on Unified Soil Classification System or U.S. Dept. of Agriculture's Soil Classification Method.

**(>10ppm TPFH by Method 5030; >40 ppm TPFH by Method 3550; >250 ppm O&G by Method 9071)

Site Sensitivity Evaluation (SSE)

Initial Cleanup Level
(Step 2)

Final Cleanup Level
(Step 3)

EPA Method 5030 for Low Boiling Point Hydrocarbons such as Gasoline, Aviation Fuels, and Gasohol			
Total Site Characteristics Score	Initial Cleanup Level TPFH (ppm)	Select Site Category*	Final Cleanup Level
>150	≤10	Select Site Category*	Category A & B (Multiply initial cleanup level by 1) <div>1 X <u>40</u> = <u>40</u> ppm</div>
121-150	20		Category C & D (Multiply initial cleanup level by 2) <div>2 X _____ = _____ ppm</div>
91-120	40		Category E (Multiply initial cleanup level by 3) <div>3 X _____ = _____ ppm</div>
61-90	60		
31-60	80		
0-30	100		

EPA Method 3550 for High Boiling Point Hydrocarbons such as Kerosene, Diesel, Varsol, Mineral Spirits, Naphtha			
Total Site Characteristics Score	Initial Cleanup Level TPFH (ppm)	Select Site Category*	Final Cleanup Level
>150	≤40	Select Site Category*	Category A & B (Multiply initial cleanup level by 1) <div>1 X <u>160</u> = <u>160</u> ppm</div>
121-150	80		Category C & D (Multiply initial cleanup level by 2) <div>2 X _____ = _____ ppm</div>
91-120	160		Category E (Multiply initial cleanup level by 3) <div>3 X _____ = _____ ppm</div>
61-90	240		
31-60	320		
0-30	400		

EPA Method 9071 for Heavy Fuels - Oil & Grease (O&G) such as Fuel Oil #4, #5, #6, Motor Oil, Hydraulic Fluid			
Total Site Characteristics Score	Initial Cleanup Level TPFH (ppm)	Select Site Category*	Final Cleanup Level
>150	≤250	Select Site Category*	Category A & B (Multiply initial cleanup level by 1) <div>1 X <u>550</u> = <u>550</u> ppm</div>
121-150	400		Category C & D (Multiply initial cleanup level by 2) <div>2 X _____ = _____ ppm</div>
91-120	550		Category E (Multiply initial cleanup level by 3) <div>3 X _____ = _____ ppm</div>
61-90	700		
31-60	850		
0-30	1000		

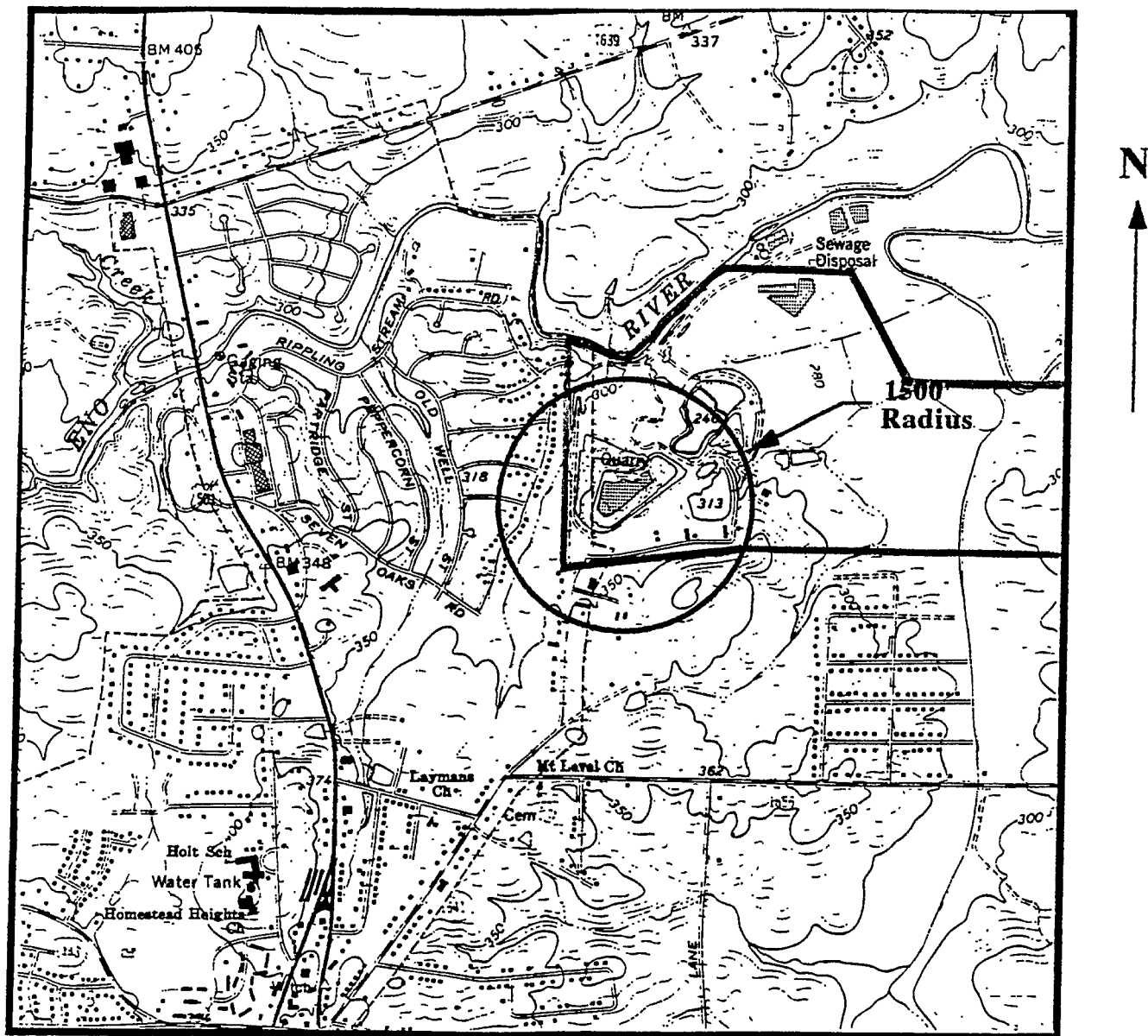
* See Site Category Descriptions, Table 3
NCDEM Guidelines 3/10/93

POTENTIAL RECEPTORS & MIGRATION PATHWAYS

A walkover survey, interviews, and a search of County Health Department well records were used in conjunction with the USGS topographic map of the Northwest Durham 7.5 minute Quadrangle to locate water supplies within 1,500 feet of the subject site (USGS, Revised, 1987). Fifteen potential receptor wells, including the five supply wells on site, were found within a 1,500-foot radius of the former service station. A list of the well owners is provided in Table 1, and is keyed to the Well Inventory Map, Figure 3.

Table 1. - POTENTIAL RECEPTOR WELLS

<u>OWNER/RESIDENT</u>	<u>ADDRESS</u>
Aron	4807 Denfield Street
Church of God	Denfield Street
Albert Lee Deer	4911 Denfield Street
Wright	4907 Denfield Street
W.T. Proctor, Inc.	4918 Denfield Street
Walters	4921 Denfield Street
Lee's Welding	1002 Communication Drive
Joann Harris- Mobile Communications	1003 Communication Drive
D.W. Ward Construction Co.	Denfield Street
Mayo Farms Trucking Co.	4934 Denfield Street
Teer Company, 5 supply wells	Durham Quarry



Northwest Durham 7.5 min. Quad
USGS, 1987 (Revised)

Figure 3 - Well Inventory Map

The only identified surface water for a public water supply is the Eno River, located approximately one-half mile north of the former service station. It flows in an easterly direction into the Neuse River. The large quarry pit separates the contaminated area from the Eno River. An out-of-service water supply inlet, owned by the City of Durham, is downstream from the sewage treatment plant, and has been disconnected for approximately three years (personal communication, Durham Water Resources Division, October 11, 1993).

Municipal water is available to other area residences and businesses from the City of Durham Public Works Department. The local water main turns east at Hebron Road (SR 1656) off of Denfield Street, approximately 3,000 feet south of the Quarry entrance. Two water supply pipelines, 24-inch and 42-inch diameter, are deeply buried in a trench which traverses the Teer property along a 50-foot easement granted to the City of Durham (see Figure 2). These mains supply the areas north of the Eno River. A sewer main also traverses the eastern side of the Teer Property along a 30-foot easement, to bring wastewater to the City's treatment plant adjacent to the Eno.

The 327 acre subject site is bordered on the north by the City of Durham wastewater treatment plant property. Table 2 is a list of adjacent property owners, obtained from the Durham County Courthouse. There are no basements constructed on the site. The Quarry Office and shops are on septic tank systems which are located near the buildings.

Table 2. - ADJACENT PROPERTY OWNERS

<u>MAP</u>	<u>BLOCK</u>	<u>LOT</u>	<u>NAME</u>	<u>MAP</u>	<u>BLOCK</u>	<u>LOT</u>	<u>NAME</u>
801	1	4	Penny, Jack B.	785	2	1	Royster, Gail
		10	City of Durham	788	3	1,2,3	Nelson, C.W.
		8B	City of Durham			4	Howell, R.
		9	McKarland, W.C.			5	Holmes, Leroy
		17C	City of Durham			6	Riley, John L.
		17D	City of Durham			7	Harpe, James
		1E	City of Durham			8	Stanfield, W.J
		3A	City of Durham			9	Cheek, Wm.
						10	Noell, Eula A.
787	1	1	Central Engg. & Con.			10A	White, Lester
		2	Central Engg. & Con.			12	Overby, C.H.
		5	City of Durham			13,14	Hart, Bertha
		5A	City of Durham			15	Hart, Wm. D.
						16,17	Tate, Grady
747	1	10	Pendergrass, Bobby F.			18,19,20	Bragg, J.H.
						21	Wicker, A.D.
792	4	15	Cook, David L.			22	Hall, Roose.
		16	Flack, C.V., Jr.			23	Hall Estate
	5	1	Williams, Edgar W.			24	Nunn, Edgar L
		2	Lett, Clyde			25	Solomen, Vert
		3	Alston, Milton				
		4	Mallard, Harvey M.	792A	6	1	Durham City
		5	O'Neal, Elton M.			2	Gilbert, K.R.
		6	Richardson, Nathaniel			3	Egerton, G.G.
		7	Lemonjello, Gregory			4	Irvin, John L.
		8	Roberson, Robert L.			5	I.R.T. Prop.
		9	Gilmore, Exter G., Jr.			6	Peace, Frankie
		10	Lassiter, Barbara J.			7	Davis, Velma
		11	Johnson, Edwin V.			8	Davis, F.W.
		12	Neal, Andrew G.			9	Dennis, A.
		13	Faulken, Tracy C.			10	King, B.B.
		14	Davis, Harold R.			11	Cook, Jimmie
		15	Smith, Sherwood E.			12	Smith, Wilma
		16	Bennett, Thomas S.			13	Young, C.J.
		17	Miles, Lonnie J.			14	Mitchell, G.A.
		18	Bell, Tacho			15	Brown, Henry
		19	Peace, Larry D.		7	1	Long, Clyde
						2	Jones, P.W.
785	1	1	Swann, Louis	780	1	2	Joven Group 7
		22	Johnson, Danny B			4	Central Engg.
		23	Bankston, Mildred G.			5	Central Engg.
		24	Wright, MacArthur				
		25	Johnson, Fred, Jr.				

REGIONAL GEOLOGY & TOPOGRAPHY

The project site is situated within the Durham Basin, the northernmost portion of the Deep River Basin, within the Piedmont Physiographic Province of central North Carolina (Hoffman and Gallagher, 1989). This half-graben structural basin lies between the Western ~~Western~~ ^{Carolina} Slate Belt and the Raleigh Belt, of the Piedmont.

Surficial rocks in the area of the site have been mapped as the late Triassic-age siltstones, sandstones, mudstones, shales and conglomerates, belonging to the Sanford Formation, Chatham Group (Hoffman and Gallagher, 1989) Figure 4. These sedimentary rocks are typically maroon, tan, red and reddish-brown. Abundant outcrops are observed in the immediate vicinity of the site. The regional strike of the Triassic strata is N40° -50°E; with a southeasterly dip of 7 to 10 degrees. Thicknesses of the Triassic rocks range from zero to more than 280 feet toward the eastern side of the site.

Disconformingly below the Triassic sediments, are two very different rock units, both of which have been utilized, at different times, as quarry stone. The oldest and most durable rock consists of a suite of metavolcanics (felsic tuffs) of Paleozoic age. These are a very dark blue-gray, fine grained rock, which weathers with an iron-brown staining. The younger rock is an igneous diabase of early Jurassic age which was intruded through and into the metavolcanic and sedimentary rocks. The diabase has been emplaced as dikes, cutting across strata, or as sheets (sills) between sedimentary strata. This rock is dark gray to black, medium grained, and is classified as a diabase because its crystal grain sizes are between those of a gabbro and a basalt (Hoffman and Gallagher, 1989).

The soil developed from the Triassic sedimentary rocks is very thin to none. Most of the natural surficial material consists of reddish-tan, micaceous, silty soil, which is a deeply weathered sedimentary rock. Man-placed crushed stone and asphalt paving covers most of the quarry area.

The site is located on a wide topographic terrace (elevations 300 to 330 feet), between a large hill reaching an elevation of 397 feet, National Geodetic Vertical Datum (NGVD) south of the property, and the valley of the Eno River, flowing at an elevation of 262 feet. Quarrying operations over the past 50 years have modified the natural surface drainage. The regional drainage is eastward toward two small creeks and thence into the Eno River.

Usually, the groundwater gradient mirrors the surface topography and runoff. This is not true at this site because of the quarrying operations exceeding a depth of 180 feet BLS, the structural features (joints and faults), the Jurassic diabase intrusion, and the influence of supply wells on site. The average depth to the water table near the center of the contaminated area is 22.7 feet. However, the drilling of monitoring wells showed that the depths to groundwater range from 2 feet to more than 52 feet.

The shape of the groundwater contamination plume is elliptical, with its long axis parallel to the southern property line. It will be discussed later that the influence of supply well W-1 has pulled the contaminated groundwater downward to 260 feet, BLS, and northward toward itself, thus keeping the contamination from migrating offsite.

SITE ASSESSMENT

Soil Borings and Sampling

The soil/sedimentary rock assessment required 112 borings, 14 hand auger borings and 11 test pits in order to completely define the area and depth of contamination. Auger flights and drilling tools were decontaminated prior to beginning each new bore hole in accordance with Geonetics' Quality Assurance and DEM's sampling protocol. Representative samples were retrieved from stainless-steel split-spoons or stainless-steel hand augers and placed in cleaned sample jars for both field and laboratory analysis. Field soil assessment screening was accomplished by use of Photo-Vac MicroTip PID and Heath Porta-FID III Organic Vapor Analyzers (OVA).

Fifty-one soil samples were obtained from borings and test pits for the requisite laboratory analyses, performed by Southern Testing and Research Laboratories of Wilson, N.C. Laboratory analytical methods included EPA 5030 and EPA 3550; and other areas sampled included EPA Method 9071 and EPA Method 1311-TCLP for the eight RCRA metals. The laboratory results are summarized in Table 3. These were utilized to confirm the broader results of the field-screening OVA methodology. The laboratory results and chains of custody are contained in the Appendix. The OVA field reporting forms and Boring Logs are in the Appendix of this report.

The soil OVA measurements are summarized in Table 4, and are depicted in Figure 5. Generally, 10 ppm by OVA method, and 5 ppm TPH by lab analysis indicates soil contamination from gasoline. Figure 5 also illustrates the horizontal extent of soil contaminated by petroleum product leaks.

Table 3 - SUMMARY OF SOIL LABORATORY ANALYSES FOR THE TRUCK SHOP AREA

Teer Company, Durham Quarry, N.C.; Geonetics Project # 10293

PARAMETERS > (EPA METHOD) > (UNITS) >			8021 (601) (ug/kg)	8021 (602) (ug/kg)	9071 (mg/L) TOTAL TPH	TCLP 1311 (mg/L)	TCLP 1311 (mg/L)	TCLP 1311 (mg/L)	TCLP 1311 (mg/L)	TCLP 1311 (mg/L)	TCLP 1311 (mg/L)	TCLP 1311 (mg/L)	TCLP 1311 (mg/L)
BORING #	DEPTH (ft.)	SAMPLE DATE		VOA		As	Ba	Cd	Cr	Pb	Hg	Se	Ag
B-85	5	5/25/93	ND	53.6	572	ND	ND	ND	ND	ND	ND	ND	ND
B-86	10	5/25/93	ND	82.7	113	ND	1.59	ND	ND	ND	ND	ND	ND
B-86	15	5/25/93	ND	76.6	172	ND	3.04	ND	ND	ND	ND	ND	ND
B-86	20	5/25/93	ND	92.7	54.5	ND	1.22	ND	ND	ND	ND	ND	ND
Near B-86	2.5	5/25/93	ND	73.8	122	ND	1.76	ND	ND	ND	ND	ND	ND
B-87	5	5/25/93	ND	71.8	183	ND	ND	ND	ND	ND	ND	ND	ND
B-87	7	5/25/93	ND	116.6	128	ND	ND	ND	ND	ND	ND	ND	ND
TP-1	2.5	5/25/93	ND	97.3	ND	ND	ND	ND	ND	ND	ND	ND	ND

ND=NOT DETECTED

ug/kg = micrograms per kilograms

mg/L = milligrams per Liter

Southern Testing & Research Laboratories, Inc., Wilson, N.C.

GEONETICS CORPORATION

Table 3 - SUMMARY OF SOIL LABORATORY ANALYSES
Teer Company, Durham Quarry, N.C., Geonetics Project # 10293

PARAMETERS > (EPA METHOD) > (UNITS) >			8021 (5030) (ppm) TPH	8015 (3550) (ppm) Kerosene Group	8015 (3550) (ppm) Gasoline Group
BORING #	DEPTH (ft.)	SAMPLE DATE			
TP-2	COMP	6/15/93	7.579	52	<2
TP-3	COMP	6/15/93	0.577	<2	<2
TP-4	COMP	6/15/93	0.526	<2	<2
TP-5	COMP	6/15/93	0.849	<2	<2
TP-6	COMP	6/17/93	0.605	<2	<2
TP-7	COMP	6/17/93	0.058	<2	<2
TP-8	COMP	6/17/93	0.503	<2	<2
TP-9	COMP	6/17/93	0.742	2000	< 20
TP-10	COMP	6/17/93	1.603	<2	<2
TP-11	COMP	6/17/93	1.278	<2	<2
D-1	COMP	6/15/93	24.21	820	< 5
D-2	COMP	6/15/93	1.378	22	<2
D-3	COMP	6/15/93	0.401	340	< 5
D-4	COMP	6/15/93	116.8	2800	< 25
D-5	COMP	6/15/93	0.412	<2	<2
D-6	COMP	6/15/93	<0.275	<2	<2
D-7	COMP	6/15/93	1.055	<2	<2
D-8	COMP	6/15/93	0.571	<2	<2

GEONETICS CORPORATION

Table 3 - SUMMARY OF SOIL LABORATORY ANALYSES

Teer Company, Durham Quarry, N.C., Geonetics Project # 10293

PARAMETERS > (EPA METHOD) > (UNITS) >			8021 (5030) (ppm) TPH	8015 (3550) (ppm) Kerosene Group	8015 (3550) (ppm) Gasoline Group	(9071) (mg/kg) TPH
BORING #	DEPTH (ft.)	SAMPLE DATE				
D-9	COMP	6/15/93	<0.275	<2	<2	N/A
D-10	COMP	6/15/93	0.455	<2	<2	N/A
D-11	COMP	6/15/93	10.717	<2	<2	N/A
D-12	COMP	6/16/93	0.468	<2	<2	N/A
D-13	COMP	6/16/93	0.624	<2	<2	N/A
D-14	COMP	6/16/93	0.434	<2	<2	N/A
SB-1	2 to 4	7/19/93	0.903	<2	<2	N/A
SB-1	5 to 7	7/19/93	0.793	<2	<2	N/A
SB-1	10 to 12	7/19/93	0.479	<2	<2	N/A
SB-1	15 to 17	7/19/93	0.452	<2	<2	N/A
SB-1	20 to 22	7/19/93	0.479	<2	<2	N/A
SB-2	2 to 4	7/20/93	0.439	<2	<2	N/A
SB-2	5 to 7	7/20/93	0.419	<2	<2	N/A
SB-2	10 to 12	7/20/93	0.585	<2	<2	N/A
SB-2	15 to 17	7/20/93	0.446	<2	<2	N/A
SB-2	20 to 22	7/20/93	63	31	<2	N/A
SB-3	2 to 4	8/4/93	<0.275	<2	<2	225
SB-3	5 to 7	8/4/93	<0.275	<2	<2	105
SB-3	10 to 12	8/4/93	<0.275	<2	<2	132

GEONETICS CORPORATION

Table 3 - SUMMARY OF SOIL LABORATORY ANALYSES

Teer Company, Durham Quarry, N.C., Geonetics Project # 10293

PARAMETERS > (EPA METHOD) > (UNITS) >			8021 (5030) (ppm) TPH	8015 (3550) (ppm) Kerosene Group	8015 (3550) (ppm) Gasoline Group	(9071) (mg/kg) TPH
BORING #	DEPTH (ft.)	SAMPLE DATE				
SB-3	15 to 17	8/4/93	0.369	<2	<2	90.3
SB-3	20 to 22	8/4/93	0.304	<2	<2	167
SB-4	2 to 4	8/4/93	<0.275	<2	<2	N/A
SB-4	5 to 7	8/4/93	0.279	<2	<2	N/A
SB-5	2 to 4	8/4/93	<0.275	<2	<2	N/A
SB-5	5 to 7	8/4/93	<0.275	<2	<2	N/A
SB-5	10 to 12	8/4/93	<0.275	<2	<2	N/A
SB-5	15 to 17	8/4/93	0.323	<2	<2	N/A
MW-9 LOC. *	2 to 4	7/2/93	2.45	<2	<2	N/A
MW-9 LOC. *	5 to 7	7/2/93	9.581	200	<2	N/A
MW-9 LOC. *	10 to 12	7/2/93	19.78	775	<2	N/A
MW-9 LOC. *	15 to 17	7/2/93	0.888	<2	<2	N/A
MW-9 LOC. *	20 to 22	7/2/93	0.54	<2	<2	N/A
MW-9 LOC. *	25 to 27	7/2/93	1.407	<2	<2	N/A

NOTES:

ppm = parts per million

TP = Test Pit

D = Ditch Area Located on the South end of Property

SB = Soil Boring

* = Soil Removed During MW-9 Installation

mg/kg = milligrams per kilograms

GEONETICS CORPORATION

Table 4 - SUMMARY OF SOIL OVA DATA (parts per million)

er Company, Durham N.C.; Geonetics Project # 10293

<u>DEPTH (ft.) ></u>		<u>5</u>	<u>10</u>	<u>15</u>	<u>20</u>	<u>25</u>	<u>30</u>	<u>35</u>	<u>40</u>
<u>BORING #</u>	<u>DATE</u>								
B-1	4/23/93	0	0						
B-2	4/23/93	0	1	12					
B-3	4/23/93	0							
B-4	4/23/93	1000	18	26	26				
B-5	4/23/93	0							
B-6	4/23/93	9.5	15	1	0	0	6.5		
B-7	4/24/93	28	13	1					
B-8	4/24/93	7							
B-9	4/24/93	210	560	117	34				
B-10	4/24/93	5.5							
B-11	4/24/93	665	152	61	29	72	11	1	0
B-12	4/24/93	110	290	2	2	12	7	14	
B-13	4/24/93	570	537	16					
B-14	4/24/93	100	58	3	2				
B-15	4/25/93	125	2	5	12				
B-16	4/25/93	7.5							
B-17	4/25/93	60	23	26	3	4.5			
B-18	4/25/93	480							
B-19	4/25/93	190	450						
B-20	4/25/93	1000	240	120	15.5	28.5	16	38	
B-21	4/25/93	12	540						
B-22	4/25/93	590	96	41	17				
B-23	4/25/93	170	30	86					
B-24	4/25/93	74	45	270					
B-25	4/25/93	17	63	210					
B-26	5/1/93	4	32.5						
B-27	5/1/93	65	61						
B-28	5/1/93	18.5	77						
B-29	5/1/93	5	11						
B-30	5/1/93	15.5	21.5						
B-31	5/1/93	4.5	8.5						
B-32	5/1/93	25	4	2.5					
B-33	5/1/93	1	4						
B-34	5/1/93	25.5	3						
B-35	5/1/93	41	65						
B-36	5/1/93	11	70	80					
B-37	5/1/93	17	31	18.5	12				
B-38	5/1/93	4.5	41.5	33	60.5				
B-39	5/1/93	5							
B-40	5/1/93	1	1	140					

GEONETICS CORPORATION

Table 4 - SUMMARY OF SOIL OVA DATA (parts per million)

er Company, Durham N.C.; Geonetics Project # 10293

<u>DEPTH (ft.) ></u>		5	10	15	20	25	30	35	40
<u>BORING #</u>	<u>DATE</u>								
B-41	5/2/93	4.5	2	68					
B-42	5/2/93	0	1	440					
B-43	5/2/93	21							
B-44	5/2/93	5.5	6						
B-45	5/2/93	0	6.5						
B-46	5/4/93	2	2	18	8	5	11	8	
B-47	5/5/93	142/2*	26/4*						
B-48	5/5/93	1	0	2.5	360				
B-49	5/5/93	39	350	650					
B-50	5/5/93	1	2	2					
B-51	5/6/93	0	1	0	0				
B-52	5/6/93	0	0						
B-53	5/6/93	0	0						
B-54	5/7/93	1.5	1						
B-55	5/10/93	0							
B-56	5/15/93	6.5	188	2191					
B-57	5/15/93	1.3	2.2	0.4					
B-58	5/15/93	15.1	1.9	8.4					
B-59	5/15/93	12.1							
B-60	5/15/93	9.4	41.6	10.6	32				
B-61	5/15/93	5.6	14.4	58.2					
B-62	5/16/93	3.1							
B-63	5/16/93	2.6	4						
B-64	5/16/93	1629	64.1						
B-65	5/16/93	15.8	4.7						
B-66	5/16/93	1.5							
B-67	5/16/93	16.9							
B-68	5/16/93	3.7	3.8						
B-69	5/16/93	3.9	3.1	4.1	3.2				
B-70	5/16/93	0	1.1	2.9	3.5	5	1.7		
B-71	5/17/93	0.3	1	1.3	1.1				
B-72	5/17/93	12							
B-73	5/17/93	6.8	17.6/6*						
B-74	5/17/93	29.3	4.7	3.2	2.1	2500+			
B-75	5/22/93	3.8	2.2	4.4	4.9	20			
B-77	5/21/93	10.5	5.5	2.1	10.2				
B-78	5/21/93	5.2	72.5	13.1	10.2	9.8			
B-81	5/22/93	4.4	4.7	5.3	2.5				
B-82	5/22/93	5.6	3.3	12.1	4	3.1	4		
B-83	5/22/93	5.2	2.8						

GEONETICS CORPORATION

Table 4 - SUMMARY OF SOIL OVA DATA (parts per million)

er Company, Durham N.C.; Geonetics Project # 10293

DEPTH (ft.) >		5	10	15	20	25	30	35	40
BORING #	DATE								
B-84	5/22/93	5.9	4.8						
B-85	5/25/93	21.2							
B-86	5/25/93	8.6	5.5	4.1					
B-87	5/25/93	4.7							
B-88	5/26/93	6.7	1.9	2.9	2.4	2.8	2.1		
B-89	5/26/93	2.8	2.3	4.6	5.2				
B-91	5/26/93	2.8	2.7	2.9	4.5	3			
B-92	6/1/93	4.8	3.4	2.5	8.2	3			
B-93	6/2/93	3.9	4.7	9.5					
B-94	6/2/93	1							
B-95	6/1/93	2.2	1.1						
B-96	6/1/93	2.1	2	2.8	2.5	2.8			
B-97	6/1/93	5.7	2.5						
B-98	6/1/93	4.1							
B-99	6/2/93	2.1	1.9	1.5					
B-100	6/2/93	1.2	3	6.2	26.3	5.5	2.9		
B-101	6/3/93	2.4	2.3	3.4	5.4	4.9	4.2		
B-106	6/3/93	2.6	2.3	2.6	10.1				
B-107	6/4/93	8	2						
B-108	6/3/93	2.6	2.7						
B-109	6/4/93	7.4	20.1	22.4					
B-110	6/3/93	5.7	3.8	6.4	5.3	13.2	7.8		
B-111	6/3/93	2	9.9						
B-112	6/3/93	12.3	9.8						
B-113	6/4/93	2.9	1.6	2	11.5				
B-114	6/7/93	37.9	8.1	4.1	4	2			
B-115	6/7/93	0.5	2.7	1.2	0.7	0.6	0.7		
B-116	6/4/93	1.8	1.5	2	2.5				
B-117	6/4/93	1.9	4.1						

NOTES:

* = PPM / DEPTH

INSTRUMENT USED: PHOTOVAC MICROTIP MP1000 P.I.D.

METHOD USED: HEADSPACE

GEONETICS CORPORATION

Table 4 - SUMMARY OF SOIL OVA DATA (parts per million)

er Company, Durham N.C.; Geonetics Project # 10293

DEPTH (ft.) >	1	2	3	4	5	6	7	8	9	10	11	12	13
BORING # DATE													
TP-1 5/25/93		14.8											
TP-2 6/14/93	18.7	0	0	0	0.2								
TP-3 6/14/93	0	2.3	0										
TP-4 6/14/93					0	0	0	0.7	0	0	0	0	0
TP-5 6/14/93							0	0	0	0			
TP-6 6/17/93							0			0	0		
TP-7 6/17/93							0	0	0				
TP-8 6/17/93					0	0	0	0					
TP-9 6/17/93									0	0	0		
TP-10 6/17/93						0	0						
TP-11 6/17/93								0	0	0			
D-1 6/14/93	68.8	19.6	9.1										
D-2 6/14/93	16.1	18.1	15.2										
D-3 6/14/93	10.2	4.8											
D-4 6/14/93	129												
D-5 6/14/93	3.4	2											
D-6 6/14/93	0	0											
D-7 6/15/93	0	0											
D-8 6/15/93	0	0											
D-9 6/15/93	0	0											
D-10 6/15/93	0	3.1	0										
D-11 6/15/93	0	0	0										
D-12 6/16/93	0	0	0	0									
D-13 6/16/93	0	0											
D-14 6/16/93	0	0.2	0	0									

NOTES:

TP = TEST PIT

D = DITCH (ALONG SOUTH SIDE OF PROPERTY)

INSTRUMENT USED: PHOTOVAC MICROTIP MP1000 P.I.D.

METHOD USED: HEADSPACE

GEONETICS CORPORATION

Cross-sections A-A' and B-B', Figure 6, illustrate the vertical distribution of contaminated soil (sedimentary rocks). The deepest soil sample in each bore hole was obtained from approximately one foot above the water table, or above the point of auger refusal. The configuration of soil contamination supports the interpretation that fuels migrated downward toward the water table, initially. Then, as the groundwater migrated, the contaminants were transported along with it. During periods of seasonal water table fluctuations, the contaminants were brought up into previously clean soils, and deposited there.

The areas which will require soil remediation are shown on Figure 5 and include: the former service station; the present septic tank drain field; the former asphalt plant area; an area in front of the truck shop; and portions of that drainage ditch along and near the southern property line. The EPA threshold of 5 mg/kg for TPH and the OVA threshold of 50 ppm were used to calculate the volume of excessively contaminated soil. The sum of all areas is 124,000 ft² times an average contaminated thickness of 20 ft., gives a volume of 2.48 million ft³, which is approximately 91,852 cubic yards. A density estimate of 1.5 tons per cubic yard was utilized to calculate a weight of 137,778 tons.

Figure 6 - Cross - Sections A-A' and B-B', Soil Contamination

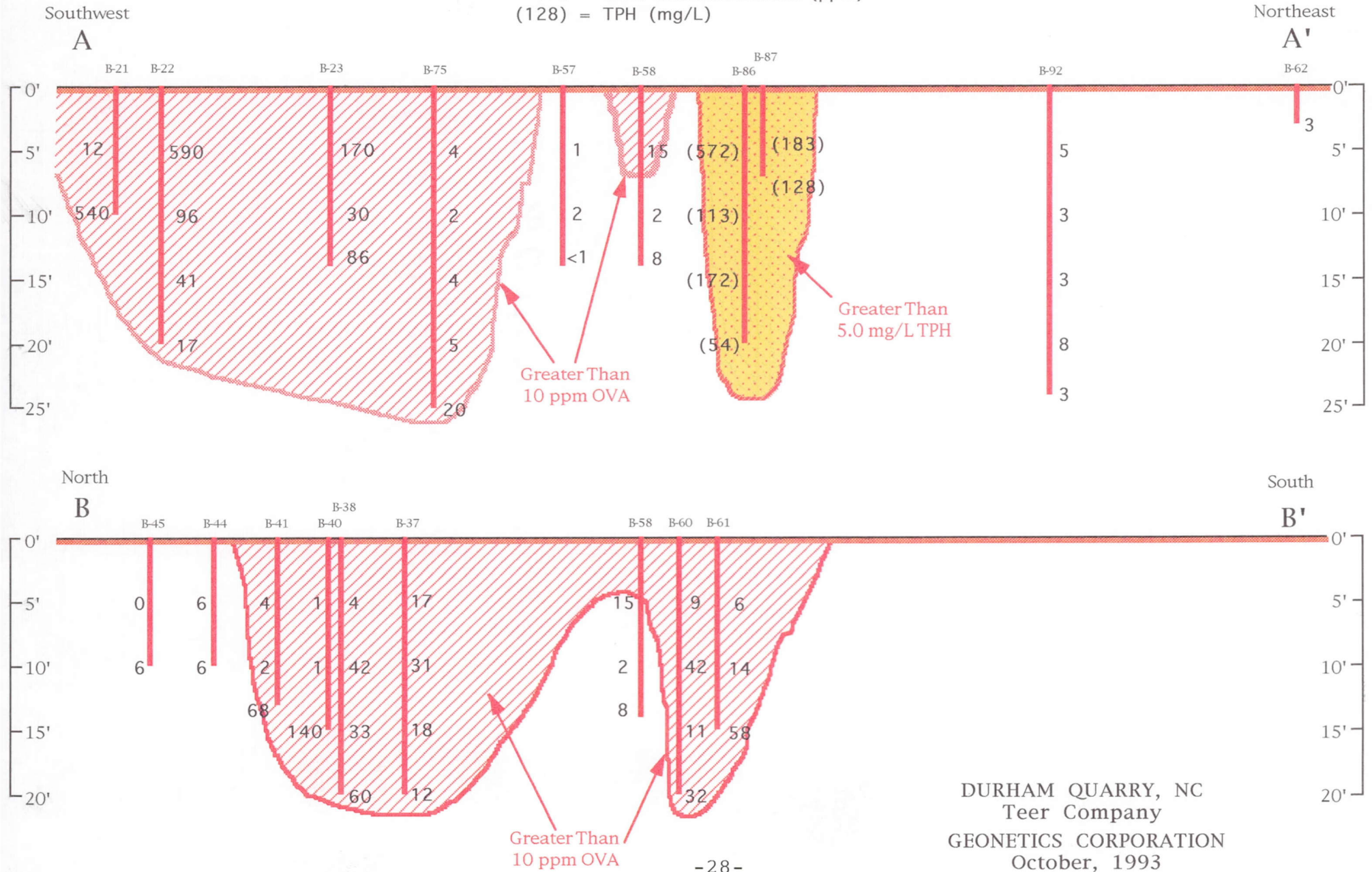
Horizontal Scale: 1" = 100'

Vertical Scale: 1" = 10'

Vertical Exaggeration = 10 X

170 = OVA MEASUREMENTS (ppm)

(128) = TPH (mg/L)



Groundwater Investigation

The field-screening OVA method guided the placement of the new monitoring wells. Five supply wells and eight monitoring wells already existed on site, and 17 new groundwater assessment monitoring wells were installed in order to define the lateral and vertical extent of this contaminant plume, and the degree of contamination. Decontamination of the drill rig and tools was performed in accord with Geonetics' QA protocol before beginning each new hole, so as not to cause any cross-contamination between wells. The Well Construction Diagrams are contained in the Appendix. Table 5, following, summarizes the construction details of each production and monitoring well.

Monitoring well drilling was performed by a down-hole hammer rig. The cuttings were stockpiled and covered for later treatment. After each monitoring well was completed with sand pack, bentonite seal and a grout seal, it was developed until the groundwater was clear. Prior to sampling, purging of the well was performed to ensure that the water sample was representative of that screened portion of the aquifer. Groundwater sampling was accomplished by use of sterile disposable bailers, to prevent the introduction of any other contamination. The purge/sampling forms are enclosed in the Appendix.

Monitoring Well 20-V was installed as the Vertical Assessment Well, to a total depth of 115 feet. Cuttings were screened by OVA, and a sudden drop to 0 ppm was interpreted to indicate that the well was below the contaminated zone. A five-foot well screen was set to obtain a water sample from a depth of 110 feet to 115 feet. The analytical results showed that the groundwater is contaminated deeper than 115 feet below land surface, there. Minor amounts of VOA constituents confirm that the bottom of the plume is still below the well screen, due to the strong pumping effects of supply well W-1.

Table 5 - WELL CONSTRUCTION DATA**Teer Company, Durham, N.C.; Geonetics Corp. Project #10293**

WELL #	CASING DIAM. (in.)	TOTAL DEPTH (ft.)	SCREEN DEPTH FROM TO	SLOT SIZE (in.)	TOP OF CASING ELEVATION (ft.)
W-1	6 **	260	18.0 - 255.0	*	323.66
W-2	6 **	400	24.0 - 395.0	*	327.52
W-3	6 **	160	23.0 - 160.0	*	323.3
W-4	6 **	162	40.0 - 110.0	*	324.81
W-5	6 **	200	22.0 - 160.0	*	316.48
MW-1	4	35	20.0 - 35.0	0.02	329.5
MW-2	6 **	52	14.0 - 52.0	*	334.04
MW-3	6 **	62	15.0 - 62.0	*	337.32
MW-4	6 **	55	40.0 - 55.0	*	323.38
MW-5	6 **	120	41.0 - 120.0	*	318.14
MW-6	6 **	67	26.0 - 65.0	*	315.09
MW-7	4	15	9.0 - 14.0	0.02	329.26
MW-8	4	28	18.0 - 23.0	0.02	315.62
MW-9	2	40	25 to 40	0.01	333.65
MW-11	2	50	35 to 50	0.01	327.87
MW-12	2	21	6 to 21	0.01	329.94
MW-13	2	65	50 to 65	0.01	326.48
MW-14S	2	20	5 to 20	0.01	327.09
MW-14D	2	49	34 to 49	0.01	327.13
MW-15S	2	17	7 to 17	0.01	329.21

GEONETICS CORPORATION

Table 5 - WELL CONSTRUCTION DATA

Teer Company, Durham, N.C.; Geonetics Corp. Project #10293

<u>WELL #</u>	<u>CASING DIAM. (in.)</u>	<u>TOTAL DEPTH (ft.)</u>	<u>SCREEN DEPTH FROM TO</u>	<u>SLOT SIZE (in.)</u>	<u>TOP OF CASING ELEVATION (ft.)</u>
MW-15D	2	40	25 to 40	0.01	329.53
MW-16S	2	13	3 to 13	0.01	333.91
MW-16D	2	61	46 to 61	0.01	330.8
MW-17S	2	12.5	2.5 to 12.5	0.01	327.59
MW-17D	2	22	7 to 22	0.01	327.3
MW-18S	2	13	3 to 10	0.01	328.43
MW-19	2	13	2 to 10	0.01	327.82
MW-20V *	6" / 2"	115	110 to 115	0.01	329.88
MW-20A	2	33	18 to 33	0.01	329.58
MW-21A	2	70	45 to 70	0.01	328.5

NOTES:

V * = VERTICAL ASSESSMENT WELL; 6" OUTER CASING TO 100'; 2" CASING TO 110';

2" SCREEN 5' LONG TO 115'

CLUSTER WELLS - "D" = DEEP WELL ; "S" = SHALLOW WELL

A = ALTERNATE WELL

* = SCREEN NOT INSTALLED, OPEN TO ROCK

** = 6" STEEL CASING

Southern Testing & Research Laboratories, Inc. performed the requisite analyses: EPA Methods 601, 602, 625 for organic hydrocarbons, and 239.2 for lead. PhosLab, Inc. performed Quality Control checks on the principal lab. Table 6 is a summary of the laboratory analyses for the groundwater samples. The Certificates of Analyses and Chains of Custody are contained in the Appendix.

Figure 7 delineates the configuration of the contamination plume using a benzene isopleth contour of 1 ug/L (ppb), the current N.C. regulatory limit. The plume is elongated in an easterly direction. Cross-sections A-A' and B-B', Figures 8 and 9, illustrate the groundwater contamination distribution beneath the site in the vertical dimension. It will be shown in the next section that the pumping influence of Supply Well 1 (W-1) has, for a considerable period of time, drawn the contamination downward and toward itself. Also, that this effect is beneficial to the remediation of the site.

The highest concentrations found were in MW-2. This is not a surprise in that it is situated closest to the tanks and the dispensers. The elevated concentrations behind and east of the former service station are most likely due to the influence of the regional eastward gradient and the surface water drainage ditch. Even though supply well (W-1) is 260 feet deep, it became contaminated because of the very short well casing and grout seal, to only 18 feet. Each time the pump would come on, it would draw shallower groundwater into the open bore. Otherwise, the contamination might have remained within 50 to 60 feet of the land surface. The volume of contaminated groundwater was estimated by surface area times average depth times a 40 percent porosity of the rock. The estimate is 4.16 million cubic feet (31.12 million gallons) of contaminated water.

It was noticed on some the analytical reports for EPA Method 601, that certain solvent constituents were detected. For example: trichloroethylene (TCE) was found at 2.1 ug/L in W-1, and also 2.1 ug/L in W-5, both below the maximum allowable concentration (MCL) of 2.8 ug/L. Tetrachloroethylene (formerly perchloroethylene; PCE) was identified in MW-6 at 2 ug/L, and W-5 at 99 ug/L. The N.C. MCL for PCE is 0.7 ug/L. Both of these wells are at the far eastern end of our study area, outside the petroleum-contaminated zone. We were advised that these cleaning solvents were formerly used by the construction company which used to operate there.

Table 6 - SUMMARY OF GROUNDWATER ANALYSES

NELLO L. TEER Co. Durham Quarry, N.C; Geonetics Project # 10293

PARAMETERS> (EPA METHOD)> (UNITS)>		BENZENES (602) (ug/L)	TOTAL VOA (602) (ug/L)	MTBE (602) (ug/L)	EDB (601) (ug/L)	IPE (601) (ug/L)	TOTAL PAH (625) (ug/L)	LEAD (239.2) (ug/L)	LAB
MONITORING WELL #	SAMPLE DATE								
W-1	5/7/93	16	22.4	N/A	N/A	N/A	N/A	N/A	So.Testing
	5/7/93	35.8	51.2	51.6	N/A	N/A	N/A	N/A	PhosLab
	5/20/93	34.4	53.4	11.8	BDL	N/A	<MCL	<1.0	PhosLab
	5/20/93	11.3	22.7	BDL	BDL	BDL	N/A	BDL	Patterson
	10/5/93	11.8	11.8	5.2	ND	ND	ND	<0.05	So.Testing
W-2	5/18/93	ND	ND	ND	ND	ND	ND	<.05	So.Testing
W-3	5/19/93	ND	0.9	ND	ND	ND	ND	<.05	So.Testing
W-4	5/18/93	ND	ND	ND	ND	ND	ND	<.05	So.Testing
W-5	5/20/93	ND	0.7	ND	ND	ND	ND	<.02	So. Testing
	5/20/93	BDL	BDL	BDL	<1.0	N/A	<MCL	<1.0	PhosLab
	5/20/93	BDL	BDL	BDL	BDL	BDL	N/A	BDL	Patterson
MW-1	5/20/93	BDL	BDL	BDL	BDL	N/A	<MCL	<1.0	PhosLab
	5/20/93	BDL	BDL	BDL	BDL	BDL	N/A	BDL	Patterson
	5/20/93	ND	0.7	ND	ND	ND	ND	0.027	So.Testing
MW-2	5/7/93	575	3244	N/A	N/A	N/A	N/A	N/A	So.Testing
	5/7/93	672	3110	23	N/A	N/A	N/A	N/A	PhosLab
	5/20/93	541	2006	105	BDL	N/A	<MCL	<1.0	PhosLab
	5/20/93	252	571	BDL	BDL	BDL	N/A	BDL	Patterson
	5/20/93	353	877	ND	ND	ND	ND	<.02	So.Testing
MW-3	5/21/93	ND	ND	ND	ND	ND	ND	0.056	So.Testing
MW-4	5/18/93	ND	0.7	ND	ND	ND	ND	<.05	So.Testing

GEONETICS CORPORATION

Table 6 - SUMMARY OF GROUNDWATER ANALYSES (CONT.)
NELLO L. TEER Co. Durham Quarry, N.C; Geonetics Project # 10293

PARAMETERS> (EPA METHOD)> (UNITS)>	MONITORING WELL #	SAMPLE DATE	TOTAL			TOTAL			LAB
			BENZENES (602) (ug/L)	VOA (602) (ug/L)	MTBE (602) (ug/L)	EDB (601) (ug/L)	IPE (601) (ug/L)	PAH (625) (ug/L)	LEAD (239.2) (ug/L)
	MW-5	5/7/93	ND	ND	N/A	N/A	N/A	N/A	So.Testing
		5/7/93	BDL	BDL	BDL	N/A	N/A	N/A	PhosLab
		5/20/93	BDL	BDL	BDL	BDL	N/A	<MCL	PhosLab
		5/20/93	1.5	12.4	BDL	BDL	BDL	N/A	Patterson
		5/20/93	ND	ND	ND	ND	ND	0.069	So.Testing
	MW-6	5/21/93	ND	ND	ND	ND	ND	0.03	So.Testing
	MW-7	5/21/93	ND	ND	ND	ND	ND	<.02	So.Testing
	MW-8	5/19/93	ND	ND	ND	ND	ND	<.05	So.Testing
	MW-9	9/9/93	ND	ND	ND	ND	ND	<0.05	So.Testing
	MW-11	9/9/93	ND	ND	ND	ND	ND	<0.05	So.Testing
	MW-12S	9/9/93	ND	ND	ND	ND	ND	<0.05	So.Testing
	MW-13	9/9/93	ND	ND	ND	ND	ND	<0.05	So.Testing
	MW-14S	9/9/93	ND	ND	ND	ND	ND	<0.05	So.Testing
	MW-14D	9/9/93	ND	ND	ND	ND	ND	<0.05	So.Testing
	MW-15S	9/9/93	10.7	95.9	8.3	ND	ND	13	So.Testing
	MW-15D	9/9/93	ND	ND	ND	ND	ND	<0.05	So.Testing
	MW-16S	9/9/93	ND	ND	ND	ND	ND	N/A	So.Testing
	MW-16D	9/9/93	ND	ND	ND	ND	ND	<0.05	So.Testing
	MW-17S	9/9/93	ND	ND	ND	ND	ND	<0.05	So.Testing
	MW-17D	9/9/93	ND	ND	ND	ND	ND	<0.05	So.Testing
	MW-18S	9/9/93	ND	1.3	ND	ND	ND	<0.05	So.Testing

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Table 6 - SUMMARY OF GROUNDWATER ANALYSES (CONT.)
NELLO L. TEER Co. Durham Quarry, N.C; Geonetics Project # 10293

MONITORING WELL #	SAMPLE DATE	TOTAL					TOTAL		LAB
		PARAMETERS>	BENZENES	VOA	MTBE	EDB	IPE	PAH / LEAD	
		(EPA METHOD)>	(602)	(602)	(602)	(601)	(601)	(625) (239.2)	
		(UNITS)>	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	(ug/L)	
MW-19	9/9/93		ND	ND	ND	ND	ND	ND	So.Testing
MW-20V	9/15/93		15	15	6.2	ND	14.2	ND	So.Testing
MW-20A	9/9/93		ND	1.8	7.3	ND	ND	ND	So.Testing
MW-21A	9/9/93		ND	ND	ND	ND	ND	ND	So.Testing

NOTES:

ND = NOT DETECTED

BDL = BELOW DETECTION LIMITS

ug/L = micrograms per Liter (ppb)

<MCL = LESS THAN MAXIMUM CONTAMINATION LEVELS

PhosLab, Inc. , LAKELAND, FL.

Southern Testing & Research Laboratories, Inc., WILSON, N.C.

Patterson Exploration Services, Inc., SANFORD, N.C.

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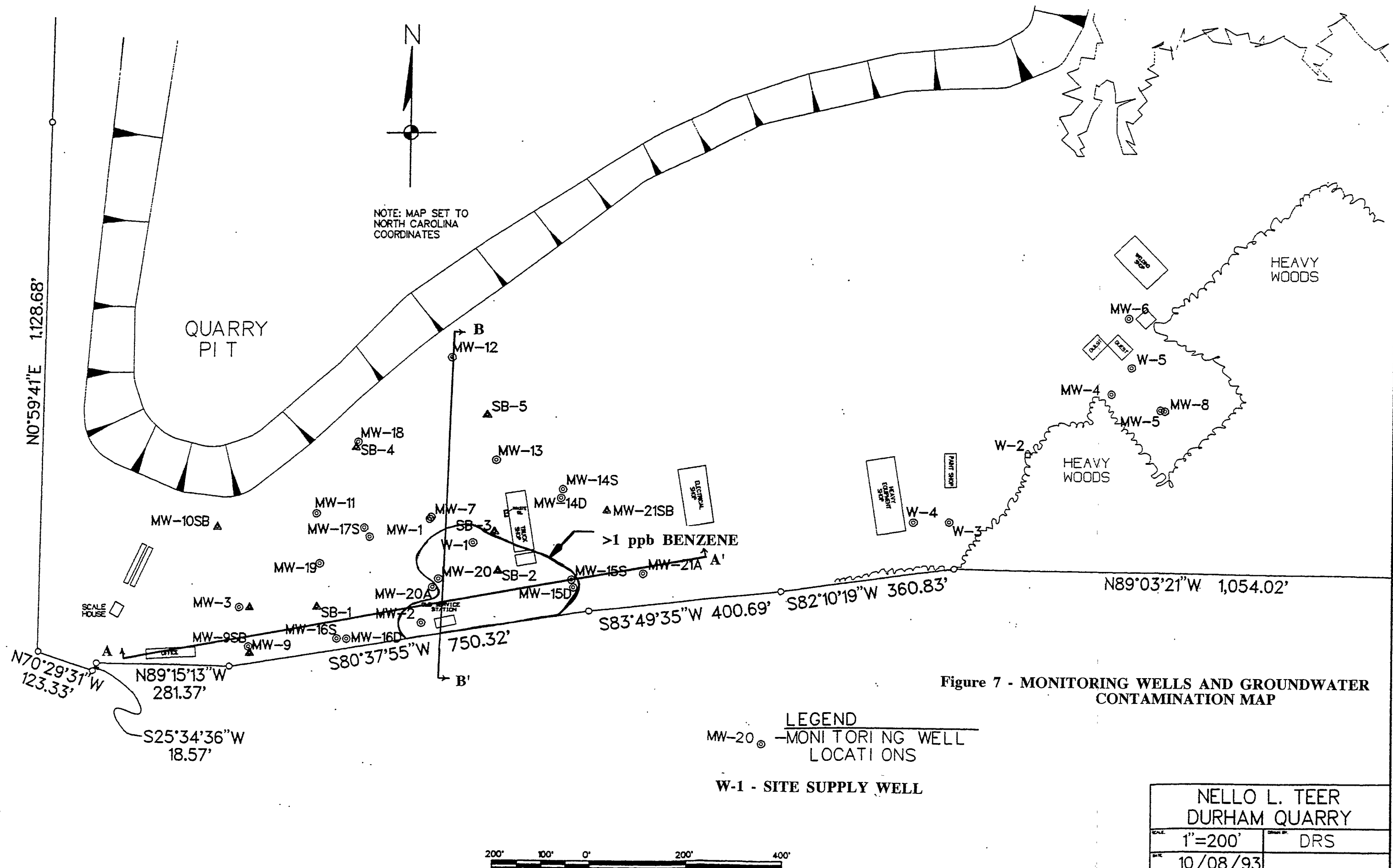
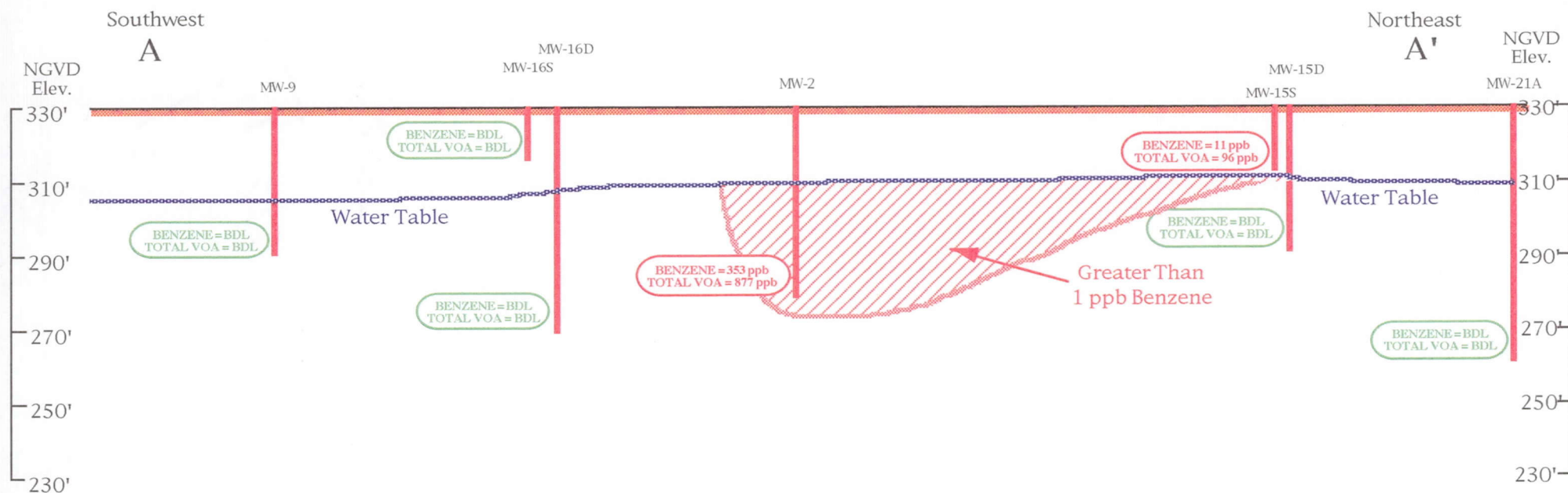


Figure 8 - Cross Section A-A', Groundwater Contamination

Horizontal Scale: 1" = 100'

Vertical Scale: 1" = 40'

Vertical Exaggeration = 2.5 X



DURHAM QUARRY, NC
Teer Company

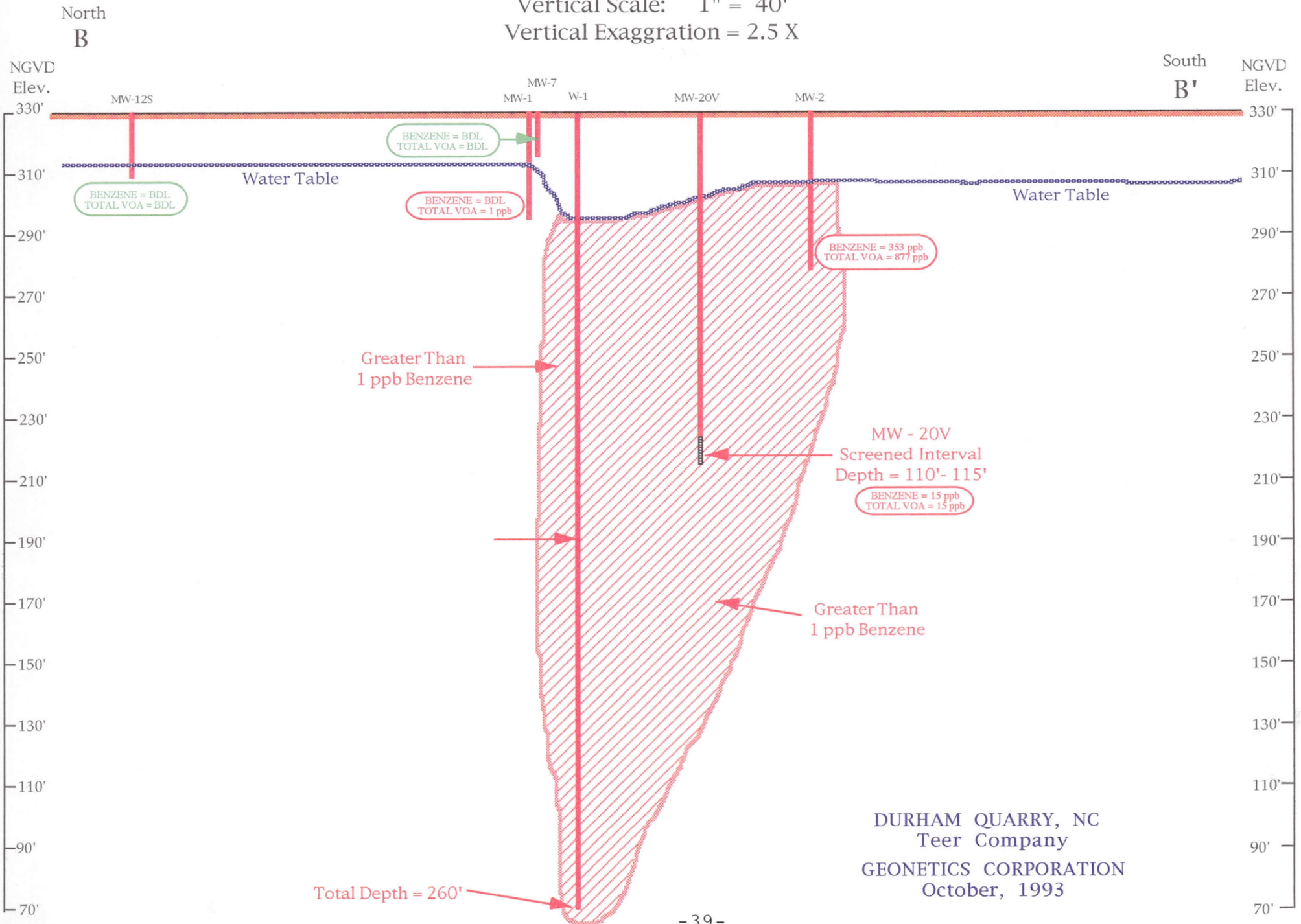
GEONETICS CORPORATION
October, 1993

Figure 9 - Cross Section B-B' Groundwater Contamination

Horizontal Scale: 1" = 100'

Vertical Scale: 1" = 40'

Vertical Exaggeration = 2.5 X



Groundwater Levels & Flow Directions

North Carolina Registered Land Surveyor, Doug Helms of Winston-Salem, was subcontracted to survey the monitoring well locations, and measuring point elevations. The site maps and property boundaries have all been redrawn to comply with the North Carolina Coordinate System.

Not only did the installation of these new wells allow for the water quality sampling, but also for determination of the groundwater flow directions. Water levels were measured on five occasions from April to October, 1993. These data are listed in Table 7. The Water Level Data Forms are contained in the Appendix. Two unconfined (water table) aquifers were encountered in this investigation. The shallow water levels, less than 20 feet, represent a perched aquifer system; whereas the deeper wells are finished into the principal water table aquifer.

Figures 10 and 11 are the Water Table Contour Maps. They illustrate that the groundwater flows in different directions at different locations across the study area. Again, note the strong drawdown influence of supply well W-1, in the vicinity of the former service station site. This pumping effect has created a cone of depression and pulled water from all directions around it, thus reducing the spread of contamination.

Gradients range from 0.014 (ft/ft) at the eastern end, to 0.214 (ft/ft) in the area around W-1. Two slug tests were performed to estimate hydraulic conductivity. The slug test in MW-1 gave a result of 8.5×10^{-5} cm/sec. MW-6 test resulted in an hydraulic conductivity of 5.5×10^{-3} cm/sec. The slug test values are in close agreement for similar sedimentary lithologies as reported by traditional authors (Davis and DeWiest, 1966) (Chow, 1964).

As this report was being finalized, a recovery and drawdown test was in progress to study the effects of pumping W-1 upon MW-20V. The base of the contaminated plume may rise above the screened interval in MW-20V and yield clean water. These hydrologic results will be helpful in the remediation design and will be reported in the CAP.

Table 7 - WATER LEVEL DATA

Teer Company, Durham, N.C.; Geonetics Corp. Project # 10293

MONITOR WELL #	MEASURE PT. ELEVATION	DATE				
		WATER TABLE ELEVATION				
		4/17/93	4/24/93	4/30/93	5/15/93	10/11/93
W-1	323.66	305.17	307.02	306.34	306.81	288.18
W-2	327.52	287.81	N/A	292.65	293.39	275.17
W-3	323.30	N/A	N/A	N/A	N/A	286.11
W-4	324.81	288.35	288.75	292.08	292.32	286.00
W-5	316.48	288.24	287.82	290.76	290.99	284.81
MW-1	329.50	315.68	315.76	315.25	315.23	311.71
MW-2	334.04	311.63	311.68	311.68	311.40	305.93
MW-3	337.32	311.99	312.14	311.73	311.20	305.55
MW-4	323.38	287.69	287.54	292.36	292.86	286.53
MW-5	318.14	293.45	292.83	294.23	294.24	287.28
MW-6	315.09	286.36	286.64	291.21	291.32	285.01
# MW-7	329.26	319.14	319.23	318.92	318.92	317.45
MW-8	315.62	292.40	292.14	291.01	292.30	287.32
MW-9	333.65	*	*	*	*	305.08
MW-11	327.87	*	*	*	*	290.73
# MW-12	329.94	*	*	*	*	320.51
MW-13	326.48	*	*	*	*	299.52
# MW-14S	327.09	*	*	*	*	310.75
MW-14D	327.13	*	*	*	*	309.70
# MW-15S	329.21	*	*	*	*	318.93
MW-15D	329.53	*	*	*	*	310.67
# MW-16S	333.91	*	*	*	*	DRY
MW-16D	330.80	*	*	*	*	302.49
# MW-17S	327.59	*	*	*	*	323.91
MW-17D	327.30	*	*	*	*	324.03
# MW-18	328.43	*	*	*	*	323.70
# MW-19	327.82	*	*	*	*	325.73
MW-20A	329.88	*	*	*	*	305.97
MW-20V	329.58	*	*	*	*	299.46
# MW-21A	328.50	*	*	*	*	309.02

NOTES:

Water Level Measurements taken with Electric Tape

N/A = Water Level not measured on this date

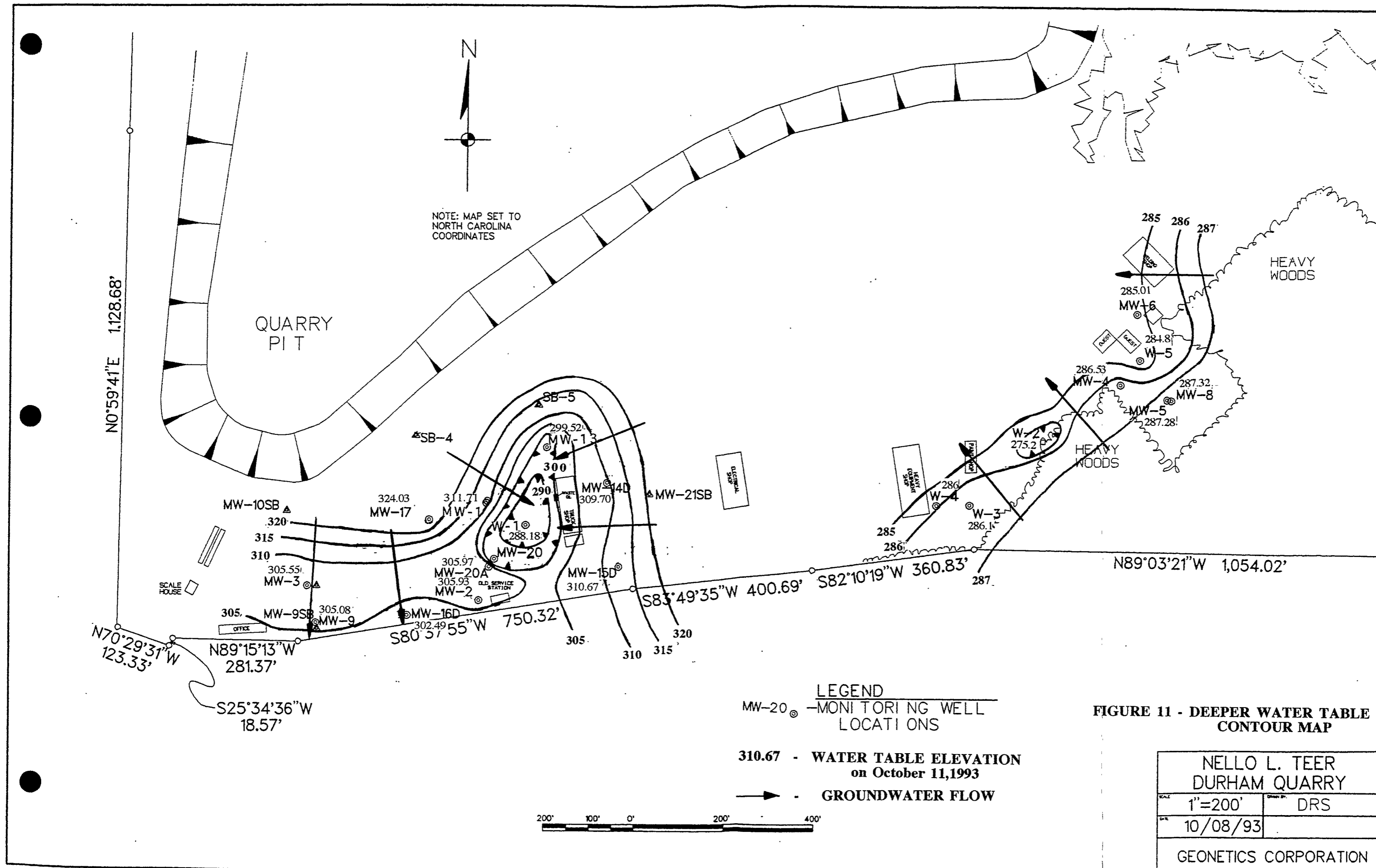
* = Wells not Installed at this time

= Shallow Wells used on Perched Water Table Contour Map

D = Deeper Well

V = Vertical Assessment Well

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LEGEND

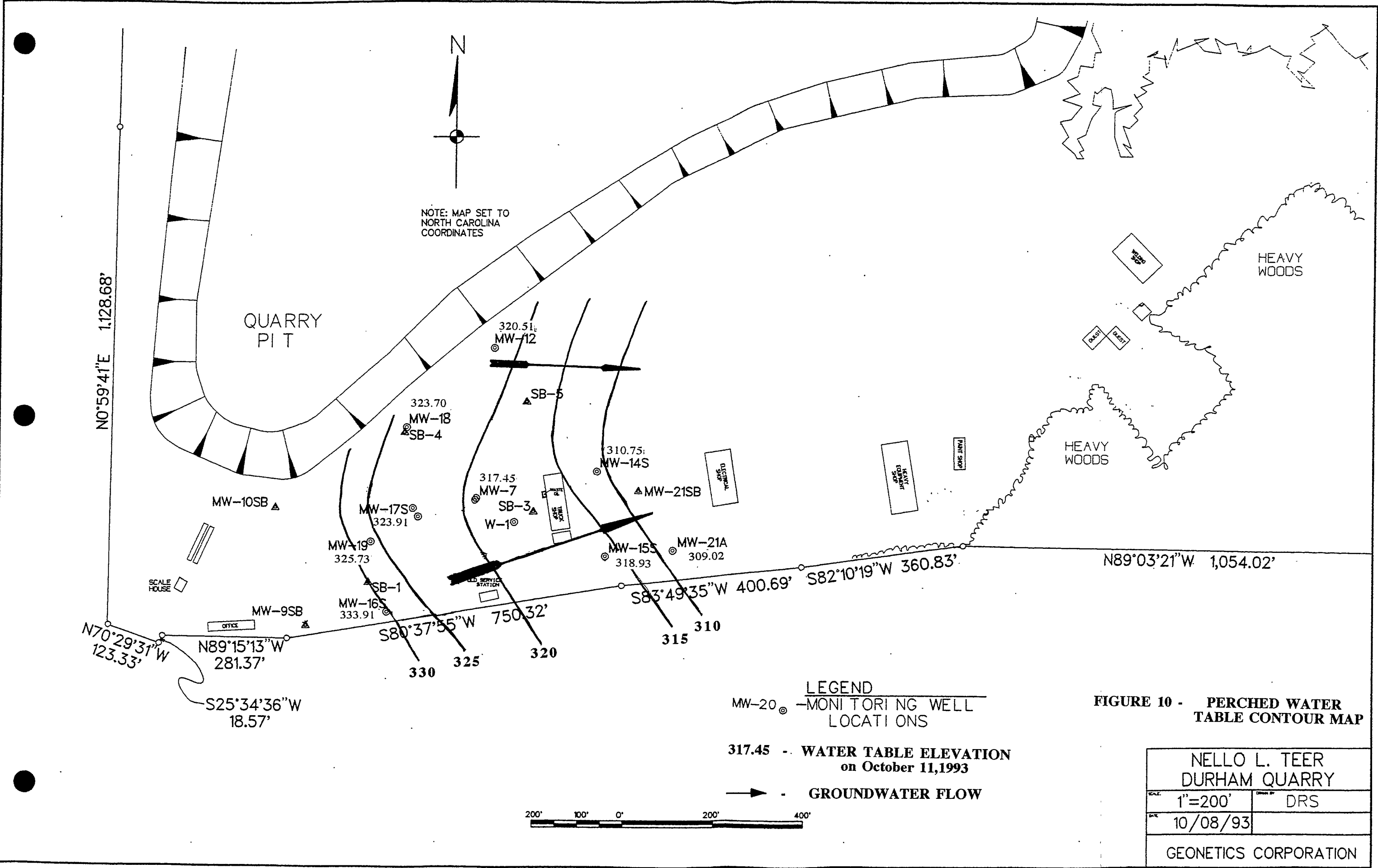
MW-20 ⊙ - MONITORING WELL LOCATIONS

310.67 - WATER TABLE ELEVATION on October 11, 1993

→ - GROUNDWATER FLOW

FIGURE 11 - DEEPER WATER TABLE CONTOUR MAP

NELLO L. TEER DURHAM QUARRY	
SCALE 1"=200'	Drawn by DRS
DATE 10/08/93	
GEONETICS CORPORATION	



CONCLUSIONS AND RECOMMENDATIONS

The category of contamination has been shown to be primarily from gasoline, diesel and oil leaks and/or spillage. No free product was found upon the groundwater from these tank, line, or dispenser leaks. Residual soil contamination is documented to be outside of the area of the tanks, and has migrated toward supply well W-1. It appears that the fuel travelled downward through the silt-clay soils until intersecting the water table.

The groundwater flow directions have been confirmed to be in various directions. Hydraulic conductivity is very low, estimated to be between 10^{-3} and 10^{-5} cm/sec. The contaminated groundwater has migrated northward toward W-1, and eastward following the shallow water gradient. The contamination appears to have remained on site.

Following, is the Preliminary Corrective Action Plan (CAP) for this site. Corrective action will be addressed for both soils and groundwater:

Soils: The estimated quantity of contaminated soils is 137,778 tons (91,852 cubic yards). The contaminated soils are located around the former service station, the former asphalt plant, the existing septic tank drain field, in front of the truck shop, and along the surface water drainage ditch. The cost to remediate the soil through on-site bioremediation is estimated to be about \$190,000.

Groundwater: The estimated quantity of contaminated groundwater is about 31.12 million gallons (4.16 million cubic feet). The groundwater remediation equipment will be sized to process as much water as can be handled by the recovery pump in well W-1. It is hoped that the system will be able to operate at least 10 to 20 gpm in order to expedite cleanup of this site.

The contaminated groundwater can be remediated using an air sparging system and/or granular activated charcoal. The system utilizes off-the-shelf technology and equipment to remove pollutants from the contaminated aquifer. The contamination will be removed from the groundwater to an acceptable level as opposed to complete removal. This is to be accomplished by passing the groundwater through an air sparger (low profile air stripper) and then through a two-stage carbon filter giving a removal efficiency that should reduce all contaminants in the water to a level at or below regulatory limits. Treated groundwater will be either recharged back into the surficial aquifer or permits for surface discharge modified.

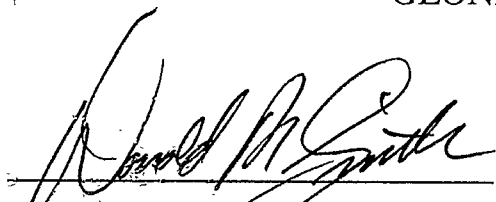
Currently, one recovery well is planned as the existing well located within the contamination plume. Additional recovery wells can be installed should the planned wells fail to give either the needed radius of influence or the gallons per minute (gpm) needed to expedite the cleanup in a timely manner. The cleaned groundwater will be recharged back into the surficial aquifer through an infiltration gallery or injection wells or discharged into surface systems.

This site is eligible for reimbursement from the Commercial Trust Fund. To remain eligible, the Corrective Action must proceed as directed by the Raleigh Regional Office and to mitigate the spread of contamination, in accordance with 15A NCAC 2N. Geonetics Corporation is now preparing the Corrective Action Plan. The Corrective Action will commence as soon as this CAP is approved. If there should be any questions or need for clarifications, please contact one of our offices listed on the cover page.

REPORT CERTIFICATION

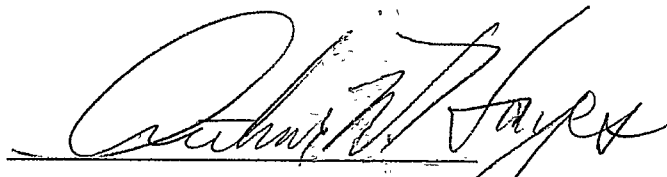
The work activities relating to this Comprehensive Site Assessment at the Durham Quarry were performed under the supervision of three licensed Professional Geologists: Dr. Arthur W. Hayes, Geonetics' President and Senior Hydrogeologist, and Donald R. Smith, Division Manager, based in Lexington, N.C., and Steven S. Edgerton, Chief Geologist, The Teer Company. The information contained herein, and the interpretations derived, follow accepted and approved professional practice, and are true and correct to the best of our knowledge. It is understood that interpretations and conclusions are derived from dated samples and measurements, and that conditions may change through time and in three dimensions within the Earth.

GEONETICS CORPORATION



Donald R. Smith, P.G.

Date: 29 Oct 93



Arthur W. Hayes, Ph.D., P.G.

Date: Oct 28, 1993

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APPENDIX

Soil Boring Logs
OVA Measurements
Laboratory Soil Analyses
MW Construction & Drilling Logs
Monitoring Well Data Forms
Groundwater Analyses
Water Level Measurements

APPENDIX
to the
COMPREHENSIVE
SITE ASSESSMENT

ON SHELF IN
CR

at

DURHAM QUARRY
Denfield Street
Durham County
Durham, North Carolina
DEM Facility # 0-012984
Groundwater Incident # 9357

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October 28, 1993